The following Guide Specifications for Earthwork, Section 02200, incorporates geotechnical input in general conformance with CSI format. The Architect, Structural and Civil Engineers should thoroughly review the section to confirm its applicability to the Fire Station 36 and make any necessary revisions.

Section 02200

EARTHWORK

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General Conditions and Division 1 - Specification sections, apply to work of this section.

SUMMARY:

Section Includes:
Earthwork as shown on the drawings for the following:
- General Site grading, cut, fill and finish.
- Excavation and backfill for structure construction.
- Preparation of subgrade for concrete flatwork, ramps and pavements.
- Distribution of stockpiled topsoil.
- Structural fills for foundation support.
- Utility line trenching and backfilling within building lines.

Related Sections:
- Subsurface Information: Section 02010
- Site Clearing: Section 02230.
- Trenching: Section 02321.
- Foundation Drainage Piping: Section 02635.
- Sewerage and Drainage Piping: Section 02513.
- Asphalt Concrete Paving: Section 2745
- Portland Cement Concrete Paving: Section 02753
- Concrete, Controlled Density Fill and Compaction Grouting: Division 3 sections.
- Excavation and Backfilling for Mechanical and Electrical Work: Divisions 15 and 16 sections.

DEFINITIONS:

Excavation: Consists of removal of material encountered to subgrade elevations indicated and subsequent disposal of materials removed.

Unauthorized Excavation: Consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Architect.

Unauthorized excavation, as well as remedial work directed by Architect, shall be at Contractor's expense.

Subgrade: Undisturbed earth or the compacted soil layer immediately below granular subbase, drainage fill, or topsoil materials.

Structure: Buildings, foundations, slabs, tanks, curbs, or other manmade stationary features occurring above or below ground surface.

SUBMITTALS

Test Reports-Excavating, Filling and Grading

The Owner's Geotechnical Engineer will perform the following tests, with a copy to the Contractor:

- Field density reports for fills and backfills.
- Testing reports on borrow material, including mechanical analysis, moisture-density curve and plasticity index.
- Verification of each footing subgrade.
- One optimum moisture-maximum density curve for each type of soil encountered.

QUALITY ASSURANCE:

Codes and Standards:

Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.

Geotechnical Services:

The Geotechnical Engineer will be the Owner's representative to observe the grading operations both during preparation of the site and the compaction of engineered fill. He will make visits to the site to familiarize himself generally with the progress and quality of the work. He will make field observations and tests to enable him to form an opinion regarding the adequacy of the site preparation, the acceptability of fill materials and the extent to which the earthwork construction and the relative compaction comply with the specification requirements.

PROJECT/SITE CONDITIONS:

Site Information:

Soil Investigation and test reports are available for examination as set forth in Section 02010.

Additional test borings and other exploratory operations may be made by the Contractor at no cost to the Owner.

Existing Utilities:

Locate existing underground utilities in the areas of work as specified in Section 01105. If utilities are to remain in place, provide adequate means of protection during earthwork operations.

Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult the utility owner immediately for directions. Cooperate with Owner and utility companies in keeping utilities in operation. Repair damaged utilities to satisfaction of utility owner.

Do not interrupt existing utilities serving facilities occupied and used by Owner or others except when permitted in writing by Architect and then only after acceptable temporary utility services have been provided.

Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.

Use of Explosives:

The use of explosives is not permitted.

Protection of Persons and Property:

Barricade open excavations occurring as part of this work and post with warning lights. Operate warning lights as recommended by authorities having jurisdiction.

Protect structures, utilities, sidewalks, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

Cleaning:

Excavator is required to maintain adjacent streets free of dirt accumulation arising out of work of this section. Use suitable means of cleaning equipment, streets or both and to meet requirements of authorities having jurisdiction.

PART 2 - PRODUCTS

SOIL MATERIALS:

Soil materials, whether from sources on or off site must be approved by the Geotechnical Engineer as suitable for intended use and specifically for required location or purpose.

General Fill:

General fill material shall be a soils or soil-rock mixture, which is free of organic matter or other deleterious substances. The fill material shall not contain rocks or lumps over 6″ in maximum dimension and not more than 15% larger than 2½″.

Materials from the site, if free of organic matter, rubble or other deleterious substances, are suitable for use in general fills.

Select Material:

In addition to the above requirements for general fill, select material shall be a low plasticity, non-expansive soil or soil-rock mixture having a plasticity index not greater than 15.

Imported Material:

All imported material shall be of select quality. The Contractor shall give at least 4 days notice prior to bringing imported material to the site to enable the Geotechnical Engineer to sample and test the material.

Aggregate Base:

Aggregate base for use beneath pavements, steps and walks shall conform to the requirements of Class 2 aggregate base, ¾" maximum size as defined in Section 26 of the Caltrans Standard Specifications.

Drainage Fill:

Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, reasonably uniform size, with maximum size of 1½" and not more than 3% passing a No. 200 sieve, as acceptable to the Geotechnical Engineer.

Unclassified Backfill:

Satisfactory off-site soil materials or on-site materials acceptable to Geotechnical Engineer, free of rock or gravel larger than 2" in any dimension, debris, waste, frozen materials, vegetable and other deleterious matter.

Filter Fabric:

Type 140N by TC Mirafi, or approved equal.

PART 3 - EXECUTION

EXCAVATION:

Excavation Classifications:

All excavation is to be considered as "unclassified".

Unauthorized Excavation:

Backfill and compact unauthorized excavations as specified for authorized excavation of same classification, unless otherwise directed by Architect.

Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending the indicated bottom elevation of the footing or base to the

excavation bottom, without altering required top elevation. Controlled density fill or lean concrete fill may be used to bring elevations to proper grades, when acceptable to the Geotechnical Engineer.

Additional Excavation:

When excavation has reached required subgrade elevations, notify the Geotechnical Engineer who will make an observation of conditions.

If unsuitable bearing materials are encountered at the required subgrade elevations, carry excavations deeper and replace the excavated material as directed by the Geotechnical Engineer.

Removal of unsuitable material and its replacement as directed will be paid on the basis of contract conditions relative to changes in the work.

Stability of Excavations:

Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.

Maintain sides and slopes of excavations in a safe condition until completion of backfilling.

Dewatering:

Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding areas.

Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, and soil changes detrimental to stability of subgrades and foundations.

Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

Provide dewatering system if ground water is less than two feet below bottom of spread footing.

Convey water removed from excavations and rain water to collecting or run-off areas. Establish and maintain temporary drainage ditches and other diversions outside excavation limits for each structure.

Do not use foundation trench excavations as temporary drainage ditches.

Cold Weather Protection:

Protect excavation bottoms against freezing when atmospheric temperature is less than 35^{O}F.

Excavated Material Storage:

Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.

Locate and retain soil materials away from edge of excavations.

EXCAVATION FOR STRUCTURES:

Conform to elevations and dimensions shown within a tolerance of ±0.10'; the final lateral extent of excavation for engineered fill construction, and controlled density fill or lean concrete placement shall be approved by the Geotechnical Engineer.

Foundations:

In excavating for footings and foundations, take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive concrete.

Replacement Zone:

Remove existing man-made fill materials from all areas of the building to a point at least 5' beyond the building line.

Fill material may be cleaned to remove trash, debris, organic materials and rocks over 3" in any dimension and used for backfill or disposed of off-site at Contractor's option.

Grade bottom of excavation at replacement zone to drain to the foundation and subsurface drainage system.

Underground Tanks, Basins and Mechanical or Electrical Structures:

Conform to elevations and dimensions indicated within a tolerance of ±0.10' plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, and other construction and for inspection. Do not disturb bottom of excavations, intended for bearing surface.

Excavation for Pavements:

Cut surface under pavements to comply with cross-sections, elevations and grades as shown.

Leave subgrades at elevations required for subgrade preparation, paving and base courses shown on drawings.

EXCAVATION FOR TRENCHES: (Utilities Within Building Lines)

Excavate trenches to uniform width, sufficiently wide to provide ample working room but not less than 9" on either side of pipe or conduit.

Excavate trenches to the depth indicated or required. Carry the depth of trenches for piping to establish the indicated flow lines and invert elevations. Beyond the building perimeter, keep bottoms of trenches sufficiently below finish grade to avoid freeze-ups.

For pipes or conduit less then 6" in nominal size, and for flat-bottomed, multiple-duct conduit units, do not excavate beyond indicated depths. Hand excavate bottom cut to accurate elevations and support pipe or conduit on undisturbed soil.

For pipes and equipment 6" or larger in nominal size, shape bottom of trench to fit bottom of pipe for 90^{O} (bottom ¼ of the circumference). Fill depressions with tamped sand backfill. At each pipe joint, dig bell holes to relieve pipe bell of loads and ensure continuous bearing of pipe barrel on bearing surface.

BACKFILL AND FILL:

Ground Surface Preparation:

Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface and scarify prior to placement of fills. Plow, strip, or break-up to 6" depth sloped surfaces to receive more than 6 feet of fill if steeper than 1 vertical to 5 horizontal so that fill material will bond with existing surface and step or bench the slope as required.

When existing ground surface has a relative compaction less than that specified under "Compaction" for the particular area classification, scarify, pulverize, moisture-condition to the optimum moisture content, and compact to required depth and percentage of maximum density.

Placement and Backfill:

Place acceptable soil material in layers to required subgrade elevations for each classification listed below, using specified materials.

In over-excavation and replacement zone beneath foundations, use satisfactory select quality onsite material or imported borrow.

In areas not subject to structural loads, provide unclassified backfill around structures beyond 5' from foundation wall and for embankments and landscape areas with top 6" being topsoil stockpiled on site.

For foundation wall backfill, use select quality on-site fill within 5' from wall.

Under walks, steps and pavements, use aggregate base material, for upper 4" to 8" and select quality backfill or imported borrow material where additional fill is required.

Backfill trenches with concrete where trench excavations pass within 18" of column or wall pile cap and which are carried below bottom of such pile cap. Place concrete to level of bottom of adjacent pile cap.

Do not backfill trenches until tests and inspections have been made and backfilling authorized by Architect. Use care in backfilling to avoid damage or displacement of pipe systems.

Provide a 4" thick concrete base slab support for piping or conduit less than 2' -6" below surface of roadways. After installation and testing of piping or conduit, provide minimum 4" thick encasement (sides and top) on concrete prior to backfilling or placement of roadway subbase.

Backfill excavations as promptly as work permits, but not until completion of the following:

Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, perimeter insulation, and basement and first floor slabs unless foundations are braced to prevent damage and movement.

Inspection, testing, approval, and recording locations of underground utilities.

Removal of concrete forms, temporary shoring, trash and debris.

Place backfill and fill materials in layers not more than 8" in loose depth for material compacted by heavy compaction equipment, and not more than 4" in loose depth for material compacted by hand-operated tampers.

Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content. Compact each layer to required percentage or maximum dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

Place backfill and fill materials evenly adjacent to structures, to required elevations. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around structure to approximately same elevation in each lift.

COMPACTION

Control soils and fill compaction during construction, providing minimum percentage of density specified for each area classification. Correct improperly compacted areas or lifts as directed by the Architect if soil density tests indicate inadequate compaction.

Relative Compaction Requirements:

Compact soil to not less than the following percentage of maximum dry density determined in accordance with ASTM D1557.

Engineered Fills: Compact top 6" of subgrade and each layer of backfill or fill material to 95% of maximum dry density.

Retaining Wall Backfill: Compact each layer of backfill material to 90% of maximum dry density.

Exterior Slabs, Steps, Walkways, Pavements: Compact top 6" of subgrade and each layer of backfill and aggregate base material to 95% of maximum dry density.

Unpaved Areas: Compact top 6" of subgrade and each layer of backfill or fill material at 90% or relative density.

Moisture Control: Where subgrade or layer or soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer or soil material, to prevent free water appearing on surface during or subsequent to compaction operations. Remove and replace, or scarify and air dry soil material that is too wet to permit compaction to specified density.

Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

Maintain moisture content of fill or backfill material to within optimum as determined by ASTM D1557, as follows.

Over-Excavation Replacement Zone: ..... 0 to +2%

Structural Fill Under Footings: ..... 0 to +2%

Exterior and Interior Slabs on Grade: .....0 to +2%

Pavements: ..... -2 to +2%

Non-Structural Areas: ..... -3 to +3%

GRADING

Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between such points and existing grades.

Round top and bottom of slopes and feather into undisturbed natural terrain. Avoid abrupt grade changes making smooth transitions from slopes to more level areas.

Grading Outside Building Lines:

Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes and within 0.10' of required sub or finish grade elevations. Make minor modifications as may be necessary to provide adequate drainage.

Spread stockpiled topsoil and compact to minimum 6" depth at all areas not designated for walks, paving or structures.

Grading Surface or Fill Under Concrete Flatwork:

Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 0.5" when tested with a 10' straightedge.

Compaction:

After grading, compact subgrade surfaces to the depth and relative compaction requirements for each area of classification.

Drainage Fill:

Place filter fabric on prepared subgrade with lapped edges and end following manufacturer's instructions.

Place drainage fill material on filter fabric in layers of uniform thickness, conforming to indicated cross-section and thickness.

FIELD QUALITY CONTROL:

The Owner's Geotechnical Engineer will:

Sample and test fill material from sources designated by Contractor.

Observe and report on site preparation, excavation, placement and compaction of fill, backfill, controlled density fill or lean concrete. Such observations will include all tests deemed necessary to ascertain if the work is in compliance with specifications.

Approve methods of compaction.

Issue final report to Owner on grading, excavation and compaction work.

The Contractor Shall:

Furnish access to site and facilities for observations and testing.

Furnish and install shoring or bracing, as required by local codes and ordinances, to provide safe access to areas for Geotechnical Engineer.

Notify the Geotechnical Engineer 48 hours prior to any fill or backfill operations.

Pay costs for additional compaction, observations and tests due to non-compliance with Contract Documents based on reports of geotechnical testing and observations.

EROSION CONTROL:

Provide erosion control methods in accordance with requirements of authorities having jurisdiction.

MAINTENANCE:

Protection of Graded Areas:

Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerance.

Reconditioning Compacted Areas:

Where subsequent construction operations or adverse weather disturbs completed compacted areas, scarify surface, re-shape, and compact to required density prior to further construction.

Settling:

Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

DISPOSAL OF EXCESS AND WASTE MATERIALS:

Remove excess excavated materials, trash, debris and waste materials and dispose of it off the Owner's property.

END OF SECTION 02200